

ENCAPSULATION OF FOOD INGREDIENTS

This invention relates to the preparation of food ingredients including oxygen sensitive oils or oil soluble ingredients.

BACKGROUND TO THE INVENTION

Oxygen sensitive oils or oxygen sensitive oil soluble ingredients are a significant class of food ingredients. Because of their susceptibility to oxidation the ingredients need to be in a form that is protective as well as enhancing their ease of use. Oils that are of commercial significance which fall into this category are generally those containing polyunsaturated fatty acids.

These ingredients need to be prepared in a form suitable as ingredients for general foods, novel foods, functional foods and nutraceuticals and to be storage stable under the usual transport conditions. Usually the ingredients are processed into stable oil-in-water emulsions or stable powders depending on their end use.

Powdered oils are generally formed by encapsulating the oil in protein forming an emulsion and drying the emulsion to form a powdered oil. Japanese patent 5030906 discloses such a product made by mixing diacetyl ester tartrate monoglyceride and edible oil in an aqueous sodium caseinate solution, emulsifying and drying to form a powder.

Japanese patent 5098286 discloses the encapsulation of unsaturated fatty acids, such as gamma-linolenic acids, with hydrolysed proteins such as lactalbumin, lactoglobulin and casein to prevent oxidation of the acids.

Hydrolysed proteins vary in activity according to the degree of hydrolysis and this may vary with different oils. Further the stability of the protein film encapsulating the oils is not always satisfactory. The protection against oxidation is primarily due to the hydrolysed protein preventing contact between oxygen and the unsaturated fatty acids rather than an antioxidant effect of the encapsulant.

U.S. Pat. No. 5,601,760 also discloses micro-encapsulation of milk fat and orange oils using whey proteins as the encapsulant. This patent also suggests that the whey proteins can be mixed with carbohydrates.

U.S. Pat. No. 5,143,737 discloses an animal feed supplement composed of an unsaturated oil encapsulated in a whey solution containing lactose which has been dried to form a powder and then browned to form a Maillard reaction product in the encapsulating matrix.

It is an object of this invention to provide an encapsulant that has good encapsulating properties and is also an antioxidant to protect oxygen sensitive oils or oil soluble products.

BRIEF DESCRIPTION OF THE INVENTION

To this end the present invention provides an encapsulant for oxygen sensitive oils or oxygen sensitive oil soluble substances which is prepared by reacting an aqueous mixture of a protein with a carbohydrate containing reducing sugar groups.

The reaction that occurs is between free amine groups of amino acids in the protein and reducing sugar groups in the carbohydrate. This type of reaction is generally termed a Maillard reaction, typically occurring in the non-enzymatic browning of foods. This reaction occurs during heat processing of foods. In this invention the Maillard reaction is accelerated by heating within the range of 60 to 160° C. This invention is partly predicated on the realisation that Maillard

reaction products [MRP] can exhibit anti-oxidation activity in the presence of polyunsaturated fatty acids. This invention also relies on the discovery that these Maillard reaction products formed with selected film forming proteinaceous materials produce superior encapsulants for oxygen sensitive oils or oil soluble ingredients. Although whey protein and carbohydrate were proposed as encapsulants in Pat. No. 5,601,760 there was no realisation that heating these ingredients together would greatly improve the resistance to oxygen deterioration whilst maintaining good encapsulation properties.

Thus in one embodiment the present invention provides an oil-in-water emulsion of an oxygen sensitive marine oil or other non-marine oxygen sensitive oil or an oxygen sensitive oil-soluble substance encapsulated in a protein which has been heated in the presence of a carbohydrate to form sufficient Maillard reaction product to protect the encapsulated oil from oxidation.

The oil is preferably an edible oil and the emulsion or the powder obtained by drying the emulsion, is used as a food ingredient, as well as in feed supplements.

The encapsulants of this invention are not only effective anti-oxidants but form stable robust films around the oil droplets.

Any protein useful in encapsulating oils can be used as the protein component of this invention. A carbohydrate with a reducing sugar functional group is reacted with the protein. The protein is preferably soluble and needs to be stable in the heating range of the Maillard reaction and includes casein, soy and whey proteins, gelatine, egg albumin and hydrolysed proteins with increased free amino acid groups including soy protein hydrolysate. Care needs to be taken in reacting the protein and carbohydrate to ensure that the conditions do not result in gelling or coagulation of the protein, as this will render the protein incapable of forming a good film. The preferred protein is a milk protein especially casein or whey protein isolate. Casein is the most preferred protein in many applications because of its low cost and its greater resistance to gelling during the heat treatment to form the Maillard reaction products. For infant food applications whey proteins are the preferred protein source.

The preferred carbohydrate is a sugar with a reducing group preferably selected from the group consisting of monosaccharides (eg: glucose, fructose), disaccharides (eg: maltose, lactose), trisaccharides, oligosaccharides and glucose syrups. Any reducing sugar source may be used including honey. The amount of Maillard reaction product in the protein-carbohydrate mixture is critical as an amount sufficient to provide antioxidant activity for the period of the product's shelf life is needed. Preferably the minimum reaction required between the protein and carbohydrate prior to encapsulation consumes at least 10% of the sugar present. The extent of Maillard reaction product formed can be monitored [for a particular protein/carbohydrate combination] by the degree of colour change that occurs. An alternative measure is to assay the unreacted sugar.

In another aspect of this invention there is provided a method of forming an oil-in-water emulsion of an oxygen sensitive oil or an oxygen sensitive oil-soluble substance which includes the steps of:

- Preparing an aqueous mixture of a protein and a carbohydrate which contains a reducing sugar group
- Heating the mixture from 60° C. to 160° C. for a period to allow sufficient Maillard reaction products to form without coagulation
- Dispersing said oil phase into the aqueous phase.